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Determination of the Volume of Industrial Waste from Wisconsin's Dairy Products Industry

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According to the USDA statistics, total cheese production in the United States in 1999 was 7.94 billion pounds (3). For every one pound of cheese produced, approximately 9 pounds of liquid whey result. The Food and Drug Administration defines whey as "the liquid substance obtained by separating the coagulum from milk, cream, or skim milk in cheese making" (1). This equates to almost 72 billion pounds of liquid whey produced nationally in 1999 alone. The state of Wisconsin leads the nation in cheese manufacturing, contributing 27.1 percent to the total supply (3). This means Wisconsin dairy facilities must deal with a resulting approximate 19 billion pounds of liquid whey byproduct.

Whey can be recovered and processed for a variety of uses, including in animal feed, human food products, and pharmaceuticals (4). In 1998, the United States produced over 700,000 tons of whey products. Whey is typically processed in a manner that separates proteins from the whole whey, resulting in a protein rich stream known as whey protein concentrate (WPC) and a stream that is rich in lactose and minerals, known as whey permeate. Different processing procedures can produce other types of whey include acid whey, sweet whey, reduced-lactose whey, and demineralized whey (7). In terms of the different quantities of the different whey products, in 1998 the United States produced 535,000 tons of whey powder, 130,000 tons of whey protein concentrate, and 48,000 tons of other modified whey products such as reduced lactose and demineralized whey (5).

Not every dairy facility has the capability to process whey into a usable product. The equipment required to convert whey permeate into food and animal feed products often costs more than companies can afford, in which case companies will often rely on landspreading to dispose of the whey byproduct (1). Furthermore, the Department of Natural Resources has in recent years increased restrictions on landspreading whey and whey permeate, which further complicates disposal of this byproduct. Researchers have found that whey application can improve soil conditions, but it must be monitored carefully and it must not exceed restrictions imposed by the DNR (6). In addition, unusable byproducts of the cheese making process, such as



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waste milk and in particular salt whey, are often unspreadable due to their high salt content. Facilities must then rely on such methods as their own wastewater treatment resources or otherwise ship to other wastewater treatment facilities to dispose of such products.

Objectives

Wisconsin produces over a fourth of the nation's cheese supply. Therefore, it is also producing a large quantity of whey byproduct and/or waste associated with this production. The objectives of this study were to:

- Quantify and characterize the volume of solid and liquid waste disposed of by Wisconsin's dairy products industry.
- Accumulate information on current waste management practices and inquire about innovative methods for improving waste minimization and recycling.

Materials and Methods

In order to meet the objectives of this project, a survey was sent to Wisconsin dairy products manufacturers inquiring about the volumes and nature of the byproducts from their cheese making process, as well as the costs associated with processing and disposing of them. The initial mailing of the survey was followed up with a telephone inquiry in an attempt to boost survey response.

The survey population was selected from the following SIC designations: 2021, 2022, 2023, 2024, and 2026. Dairy products manufacturers were limited to those facilities with 50 or more employees, as those were most likely to be subject to discharge regulation and therefore maintain disposal and treatment records. It was noted when companies implemented particularly successful or innovative methods. The resources of the Solid and Hazardous Waste Education Center, which has extensive experience in conducting surveys of a wide variety of industrial sectors regarding their wastes and pollution prevention efforts, were available for this project.

Results and Discussion

Seventy-one dairy facilities in Wisconsin qualified for this study by meeting the criteria of being cheese production facilities with 50 or more employees. Of the 71 that were surveyed, only 13 initial responses were received. In an attempt to generate more surveys, follow up telephone calls were placed. This generated nine more surveys. Of the 22 total responses, four did not qualify due to the fact that the facilities did not produce cheese, but rather other products that were not relevant to this study. It must also be noted that five of the 12 Foremost Farms USA located in the state sent responses. However, as a result of the follow up telephone call, one master response was sent that encompassed all 12 of the Foremost Farms USA in the state. Therefore, the five facilities that did respond were excluded because the master survey response accounted for them. As a result, 14 surveys total were considered, keeping in mind that one master survey for Foremost Farms was actually encompassing 12 facilities. The completeness of these responses varied. Some presented minimal information in order to maintain confidentiality while others provided thorough details. It is

essential to keep in mind that all results and discussion will be based on the information provided by the 14 survey responses that accounted for 25 facilities throughout the state.

The total amount of cheese produced by the 25 facilities was 905,430,000 pounds per year. The variety of total byproducts produced by the facilities is illustrated in Table 1.

Table 1. Type, Use/Disposal and Quantity of Byproducts Produced by 21 facilities in Wisconsin

Type of Byproduct	End use or Disposal Practice	Quantity per Year
Raw Whey	Unknown	737,500,000 lbs.
Raw Whey	disposed of via landspreading	38,000,000 lbs.
Dried Whey	WPC or other whey product for human consumption	928,164,000 lbs.
Dried Whey	used as animal feed	243,888,000 lbs.
Salt Whey	disposed of via own waste water treatment facility	7,468,000 lbs.
Salt Whey	unknown disposal practices	13,060,000 lbs.
Waste Milk	disposed of via landspreading	532,000 gallons
Waste Milk	disposed of via own waste water treatment facility	1,000,000 gallons
Waste Milk	disposed of via manure pits	400,000 gallons
Waste Milk	unknown disposal practices	1,500,000 gallons
Wash water	disposed of via landspreading	unknown
Sludge, Scrubbings & other wastes	disposed of via landspreading	46,936,800 lbs.
Sludge, Scrubbings & other wastes	disposed of via own wastewater treatment facility then to city facility	60,000,000 gallons
Sludge, Scrubbings & other wastes	used as animal feed	150,000 lbs.
Sludge, Scrubbings & other wastes	unknown disposal practices	3,669,000 lbs.

Based on the data presented in Table 1, it is clear that the greatest byproduct for these facilities is whey, with an astounding total of 1,968,080,000 pounds per year. Of this total, 928,164,000 pounds of the whey was further processed into WPC or other whey products for human consumption, making it the highest end use. Another important end use for the byproducts at these facilities was the processing of the whey for animal feed, for which 243,888,000 pounds per year was

done. A total of 20,528,000 pounds of salt whey was produced and approximately one-third was disposed of through the facility's own wastewater treatment resources, with the remaining two-thirds disposed of by some other undisclosed means. In addition, it is important to recognize that 737,500,000 pounds of raw whey was accounted for by the surveys. However, what this whey was used for or how it was disposed of was not specifically stated. If this information was known, it could tremendously increase both the quantity of end use product as well as the quantity of waste product.

The annual cost associated with disposing of all unusable byproduct was substantial for the facilities. Of the 25 facilities under consideration, 12 gave cost estimates for disposing of unusable byproducts. Nine of these 12 facilities relied on landspreading their wastes. Each of these nine facilities spent an average of \$118,976.33 per year to dispose of their wastes. Together, they spent approximately \$1,070,787 per year in landspreading costs. The remaining three facilities utilized either their own wastewater treatment resources, the city wastewater treatment facility, or a combination of the two. On average, the three facilities spent \$191,333.33 per year for this disposal practice. Together, they spent \$ 574,000 total in costs for wastewater treatment. The amount spent by the 12 facilities totaled \$1,644,787. The remaining eight facilities that did not supply financial cost associated with disposal stated that all unusable byproduct was either landspread at a cost based on per gallon hauled or handled at a city public owned treatment plant. According to their information, the cost of utilizing treatment plants varied but was typically three times more expensive than landspreading. Clearly, the costs of disposing of the wastes from the cheese making process are substantial for dairy facilities. In an effort to reduce such costs, efforts must be made to both improve the recycling and reuse of byproduct or find better ways to dispose of it.

Individual survey responses indicate that dairy facility operators would like to see several things happen to ease the burden of reusing and disposing of whey and other wastes. Land sites are becoming more difficult to find as the Wisconsin Department of Natural Resources has become increasingly stringent with guidelines on landspreading to protect the integrity of the soil. Permits such as the Wisconsin Pollutant Discharge Elimination System enable facilities to spread byproduct with a fertilizer value. However, approvals are more difficult to obtain for new sites to landspread on without meeting several criteria. These criteria are created for many purposes, including protecting the groundwater supply as well as protecting the land from overload of nutrients such as chloride. Therefore, it is critical for those facilities that landspread waste byproducts to find alternate disposal methods. Logically, it is even more critical for those facilities that have been landspreading all of their whey byproduct to begin utilizing this valuable byproduct rather than disposing of it.

Other concerns raised in individual survey responses varied, but ultimately came back to one universal request: that more ways to dispose or reuse the byproduct and waste from the cheese making process be developed. One facility wanted to see an increase in the volume of waste they could put in manure pits from 10 percent, the current restriction, to at least 20 percent. Another facility worried about what possible calcium limitations on wastewater could mean for them, for this was the single means by which they treated their waste. An additional facility struggled to find ways to dispose of their salt whey and emphasized that alternate disposal methods must be developed.

Another plant was dealing with increasingly stringent regulations on dried whey ingredients, while yet another desired to see an increase in the market for dried whey. Together, these concerns paint a picture that is plain. Recycling and disposal of the byproducts of the cheese making process must expand.

Wisconsin dairy facilities produce approximately 19 billion pounds of liquid whey byproduct annually in the cheese making process. This figure alone makes it evident how necessary it is to expand recycling and disposal practices for this byproduct and other wastes. Dried whey has a high potential to be recycled into animal feed, for human consumption, and for pharmaceutical purposes. This is the largest end use category for the recycling of whey byproduct by the 25 surveyed facilities. However, not every dairy facility possesses the capabilities to do this. Furthermore, the increasing environmental restrictions on landspreading make this practice a less viable option both financially and logistically for disposal. Combine this with the costs for treatment of wastes in wastewater treatment facilities plus regulations on manure pit volumes and chloride limitations, and few options are left for dairy facilities to efficiently dispose of their byproducts and waste materials. It is essential that dairy facilities do not forego the recycling potential of whey as a means of greatly reducing the amount of waste they produce. The results of this survey of 25 facilities in the state of Wisconsin show that there must be an expanded effort to increase both the recycling and the disposal of the tremendous amount of byproduct of the cheese making process that occurs in our dairy state.

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Questions? Comments? Please contact Dr. Leslie Cooperband at the University of Wisconsin-Madison

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